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HAEMOPROTEUS TINNUNCULI IN CRESTED CARACARAS (*CARACARA PLANCUS AUDUBONII*) FROM SOUTHCENTRAL FLORIDA

GARRY W. FOSTER
Department of Pathobiology, College of Veterinary Medicine, University of Florida, Gainesville, FL 32610 U.S.A.

JOAN L. MORRISON
Department of Wildlife Ecology and Conservation, P.O. Box 110430, University of Florida, Gainesville, FL 32611 U.S.A.

CHRISTINE S. HARTLESS
Department of Statistics, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL 32611 U.S.A.

DONALD J. FORRESTER
Department of Pathobiology, College of Veterinary Medicine, University of Florida, Gainesville, FL 32610 U.S.A.

ABSTRACT.—From 1994–96, 223 Crested Caracaras (*Caracara plancus audubonii*) from eight counties in southcentral Florida were examined for blood parasites. *Haemoproteus tinnunculi* was the only hematozoan seen. The overall prevalence was 28.2%. Prevalence was higher for adults (50.0%) than for nestlings (20.4%, $P = 0.0001$). There were no differences in prevalence of infection between years ($P = 0.8899$). The only significant interaction was between age and sampling month ($P = 0.0027$). The adult birds had a constant prevalence from February–May, while nestlings had an increasing prevalence over the same time period. This is the first report of *Haemoproteus tinnunculi* in Crested Caracaras.

KEY WORDS: Caracara plancus audubonii; Haemoproteus tinnunculi; *Crested Caracara; blood; parasite.*

Haemoproteus tinnunculi en caranchos comunes (*Caracara plancus audubonii*) en el sur y centro de Florida

RESUMEN.—Deste 1994 hasta 1996, 223 caranchos comunes (*Caracara plancus audubonii*)de ocho condados en el sur y centro de Florida fueron examinados para parásitos sanguineos. *Haemoproteus tinnunculi* fue el único hematozoaio encontrado. La prevalencia en general fue 28.2%. La prevalencia en adultos fue mas alta (50.0%) que en las crías (20.4%, $P = 0.0001$). No hubo differencias en las prevalencias de infeccion entre los años ($P = 0.8899$). La única interaccion significante fue entre la edad y el més en que se colectó la muestra ($P = 0.0027$). Los adultos tuvieron una prevalencia constarite de Febrero hasta Mayo, mientras que la prevalencia en las crías fue subiendo durarte el mismo perido. Este es el primer reporte de *Haemoproteus tinnunculi* en caranchos comunes.

[Traducción de Tânia Cames]

The Crested Caracara (*Caracara plancus*) has a fragmented geographic distribution occurring from northern Mexico to Tierra del Fuego in South America, and in North America in Texas and Arizona, with an isolated population in southcentral Florida (Morrison 1996). The blood parasites of these medium-sized raptors have not been studied thoroughly. We are aware of only three published blood parasite surveys, which included samples from two Crested Caracara subspecies. Carini and Maciel (1916) reported *Haemoproteus* sp. in a Crested Caracara (*C. p. plancus*) from Brazil, Renjifo et al. (1952) reported *Haemoproteus* sp. in three of four Crested Caracaras (*C. p. cheriway*) in eastern Colombia, and Gabaldon and Ulloa (1980) reported three undetermined species of *Plasmodium* in two nestling *C. p. plancus* collected in Venezuela. The presence of an unidentified species of *Haemoproteus,* in Crested Caracaras (*C. p. audubonii*) from Florida, was mentioned in the account by Morrison (1996), but no specific data were given. The impact blood parasites may have on the caracara's survival in Florida is unknown. The objectives of this study were to determine the species

and prevalence of blood parasites in the subspecies of Crested Caracara from Florida.

METHODS

During the January–July breeding season from 1994–96, we examined 223 Crested Caracaras from eight counties in southcentral Florida for blood parasites. We sampled 175 nestlings (5–8 wk old), and 48 breeding adults (3+ yr old). Birds in the age span between nestling and breeding adult were not sampled. Most nestlings were captured by hand from nests in the morning. During the capture process, a few older nestlings jumped from the nest to the ground where they were caught. Adult birds were captured using the methods of Morrison and McGehee (1996).

Thin blood films were prepared from peripheral blood, air dried, fixed in absolute methanol, and stained by standard Giemsa technique for 1 hr at pH 7. A minimum of 10 000 red cells was examined at 400× and 1000× oil immersion to determine the presence of parasites in each sample.

A generalized linear model with logit link and binomial errors was fit to the data to test the effects of age class, sample year, and sampling months on the prevalence of any parasites seen. Age class and sampling year were included in the model as factors with fixed levels, and sampling month was included as a linear covariate. All possible interactions were included, and those with $P > 0.20$ were deleted from the final model. This model was fit with the GLIMMIX macro described by Littell et al. (1996) for SAS 6.12 (SAS Institute, Cary, North Carolina, U.S.A.). Because few birds were sampled in January, June, and July, only those sampled between February–May ($N = 205$) were included in the statistical analysis. The significance level was set at $\alpha = 0.05$ for all tests.

Representative blood films have been deposited in the collections of The International Reference Centre for Avian Haematozoa, Queensland Museum, South Brisbane, Queensland, Australia (Accession Nos. G462377–G462431); the U.S. National Parasite Collection, Beltsville, Maryland, U.S.A. (Accession Nos. 87058–87061); and the Harold W. Manter Collection, University of Nebraska State Museum, Lincoln, Nebraska, U.S.A. (Accession Nos. 39289-39292).

RESULTS AND DISCUSSION

Birds sampled by month were as follows: January (8 nestlings, one adult), February (17 nestlings, 14 adults), March (58 nestlings, nine adults), April (60 nestlings, 13 adults), May (22 nestlings, 12 adults), June (five nestlings, no adults), July (four nestlings, no adults).

Haemoproteus tinnunculi was the only hematozoan seen in blood samples. Immature forms of the parasite tended to develop in a polar or subpolar position within the erythrocytes. Multiple infections within an erythrocyte were common, with up to six trophozoites in a single cell. The pigment granules were small, randomly scattered, and averaged 21 in mature gametocytes. The average number of pigment granules was less than the average of 23 reported by Peirce et al. (1990) from a Eurasian Kestrel (*Falco tinnunculus*). This variation could be due to interhost parasite variation. All other parameters were consistent with *Haemoproteus tinnunculi.*

Table 1. Characteristics of infection of *Haemoproteus tinnunculi* in 223 Crested Caracaras sampled in Florida between 1994–96.

	NESTLINGS		ADULTS		ALL	
COUNTY	*N*	NO. INF.	*N*	NO. INF.	*N*	NO. INF.
DeSoto	8	5	2	1	10	6
Glades	39	2	12	4	51	6
Hendry	3	1	1	1	4	2
Highlands	67	20	19	10	86	30
Indian River	2	0	—	—	2	0
Okeechobee	53	12	14	7	67	19
Osceola	2	0	—	—	2	0
Polk	1	0	—	—	1	0
Totals	175	40	48	23	223	63

The overall prevalence, disregarding county, year, and age, for the 223 birds sampled was 28.2% (Table 1). For the 205 birds included in the statistical analysis, the prevalence was 20.4% for nestlings and 50.0% for adults.

Bird age and sampling month had a significant effect on the prevalence of *Haemoproteus tinnunculi* ($P = 0.0001$ and $P = 0.0294$, respectively); however, there was also a significant interaction between age and sampling month ($P = 0.0027$). There was no significant change in the prevalence in adult birds during the sampling months (test slope equal to zero, $P = 0.5410$), and the overall predicted prevalence was 50.1% (Fig. 1). The prevalence in nestlings increased from February to May (test slope equal to zero, $P = 0.0004$) (Fig. 1). In February, the predicted prevalence for nestlings was 4.6%, and increased to 46.4% in May. Prevalences of *Haemoproteus tinnunculi* did not vary annually ($P = 0.8899$).

Adult caracaras were more likely to be infected than nestlings ($P = 0.0001$), which was probably due to the duration of exposure to vectors. Nestlings were sampled from 5–8 wk of age. All adults sampled were breeding and in adult plumage, so they were at least 3 yr of age (Morrison 1996). These older birds had a much greater opportunity to be infected and probably acquired the infection

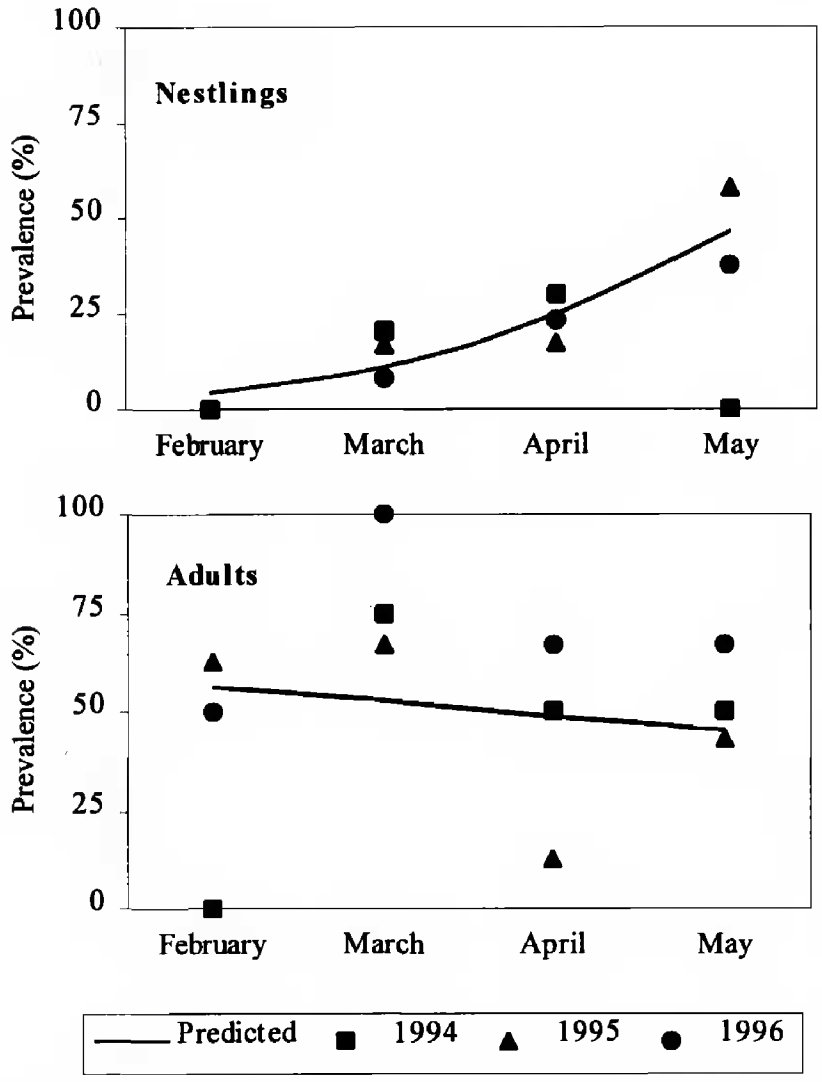

Figure 1. The predicted prevalence and observed annual prevalence of *Haemoproteus tinnunculi* over the sampling season for nestling and adult Crested Caracaras. In February of 1994, 1995, and 1996, no sampled nestlings were infected.

at a much earlier age. One free-ranging adult caracara that was tested positive in July 1992 was still positive in April 1996 indicating that the parasitemias may be very long-lived, or reinfection may be a common occurrence. The increase in probability of infection in nestlings from February to May could be a function of both an increase in the biting activity of arthropod vectors as the temperatures increase in the spring, as well as an increase in the population of arthropods which serve as vectors. Atkinson et al. (1988) reported the year-round presence of *Culicoides edeni,* the vector for *Haemoproteus meleagridis* in Wild Turkeys (*Meleagris gallopavo*), and three other ornithophilic *Culicoides* species in Glades County. They reported also lower numbers of *Culicoides* and lower biting activity during the cooler winter months, with trap collections peaking in March and April. This peak in trapping collection of *Culicoides* corresponds with the peak in nesting activity for the Crested Caracara in Florida.

Bennett et al. (1993) reviewed the pertinent literature and concluded that species of *Haemoproteus* do not have a major impact on wild bird populations and cause little direct mortality to individual free-ranging birds. However, Peirce (1989) stated that under certain conditions hematozoans could have significant pathogenic effects on hosts that had concurrent infections with other disease agents. Morrison (unpubl. data) found that late season caracara nests have lower fledging rates, and the fledglings from those late nests have lower long-term survival rates, when compared with early season fledglings. It is unclear if *Haemoproteus tinnunculi* could be one of the factors in the increased mortality of caracaras that fledge late in the season. Additional late season stresses on these nestlings may include increased temperature and decreased food resources.

Roosting at night in cabbage palms (*Sabal palmetto*) up to 20 m high and foraging on the ground and perching on fence posts or vegetation (<2 m high) during the day allows the caracara to be exposed to insect vectors that may be vertically stratified. A distinct vertical distribution of ornithophilic *Culicoides* was reported by Tanner and Turner (1974) in a Virginia forest. Most of the ornithophilic species of *Culicoides* they trapped increased in numbers as the trap height increased, with few or none found at ground level. In Florida, however, *Haemoproteus tinnunculi* transmission to caracaras took place as high as 7–20 m in the nesting trees, the same trees in which the adult birds roosted during the nonbreeding season. Further study is needed to fully understand the relationship of *Haemoproteus tinnunculi,* its insect vectors, and the mode of transmission to Crested Caracaras in Florida.

Forrester et al. (1994) reported an overall prevalence of 26% for *Haemoproteus* in Falconiformes (excluding Crested Caracaras) in Florida. This is comparable to the 28% prevalence for all the caracaras we sampled. *Haemoproteus tinnunculi* has been reported in the American Kestrel (*Falco sparverius*) in Florida (Forrester et al. 1994), but this is the first report from Crested Caracaras.

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